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EDITORIALS

PLANT BREEDING IN THE TROPICS

The tropics of the world offer fields for investigation and practical work in plant breeding, rich beyond the wildest dreams of the plant breeder of cold countries. Scarcely any of the numerous valuable fruits of the tropics have felt the ameliorating touch of the plant breeder. Ages of extensive seed planting have produced a wealth of seedling varieties to select from, that out-burbanks Burbank himself. Probably above one thousand distinct varieties of bananas occur in Malayan countries, and several thousand varieties of rice in the Indo-Malayan region. Many of the very valuable tropical fruits have never even had anything that could justly be called cultivation, to say nothing of betterment by the modern methods of plant breeding.

In Java, the Dutch are now applying modern methods of breeding to cinchona (quinine), coffee, and rubber. But such methods have never yet effectively reached tropical crops of such primary importance as coconut, banana, abaca, sisal, sesamum, cassava, yams, tropical corns, and so on. Active work along these lines is being contemplated or taken up in many tropical countries, and the next few decades may see some of the most interesting and important plant breeding results yet obtained.

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THE FOREIGN SUGAR MARKET

The Philippine sugar planters have been for the past eight months retrenching to meet a very real depression caused by the sudden deflation of post-bellum sugar prices. Some day, we may view this shakeup as a blessing in disguise. The consolidation of financing of centrals, the deflation of fiat bank credits, the general "squeezing out of water", and the incentive to minimum production costs are conditions of economy to be depended on to rebuild this important bloc of rural wealth.

In the meantime our readers will be pleased to have encouraging news from the foreign sugar market. Two statements are given below from the *Louisiana Sugar Planter* and are from the pen of Doctor Geerligs, the famous European sugar authority.

> The Associated Java Sugar Producers have sold their entire crop of 24 million piculs at the average price of 15 guilders per picul, which, after

all, still leaves a handsome profit. One factory has ended the campaign with an average return of 18.500 kilos per hectare, or 7.38 long tons per acre.

The total European sugar production of 1921-1922 is estimated by the most competent statisticians to be somewhat under four million tons, while the requirements of that part of the world, expressed in raw sugar value, are supposed to be a little over six million tons, thus necessitating the importation of over two million tons. The stocks on the continent at the outset of the new campaign are next to nothing and may be estimated at 200,000 tons all told, without any appreciable invisible supply. In the United Kingdom the visible stocks are slightly over 300,000 tons, but with a rather considerable invisible stock, accumulated during the last months. The total European stock on the first of September was therefore equivalent to one month's consumption and the sugar for the new campaign is only available in the beginning of October, so that at that date Europe will be completely without stock, while the growing crop is only sufficient for two-thirds of its normal requirements. Under these conditions we are wondering why people always continue complaining about over-production and congested markets: only because in Cuba the disposal of the stock is not so smooth as is wished for.

AGRICULTURAL COURSES

On account of crowded conditions, the short course in one of the agricultural colleges has dispensed with the study of English. If there is any one subject above all others that ought to be included in a course of agriculture it is the English language. Better less practical agriculture and more of the fundamentals than the reverse.

There is a growing tendency in our agricultural colleges to make them mere trade schools. Half of the agricultural instruction could be dispensed with if the fundamental subjects upon which agricultural practice and scholarship are based are given proper attention. After nearly thirty years' experience since passing out of an agricultural college we say it solemnly that if we were writing an agricultural course we would include four years of language and four years of science as the basis of the course. The rest of the time could be filled in with any recognized course of agricultural standing.

One thing is certain, students graduating from an agricultural college would be able to express their ideas, they should have ideas to express, and should have developed the capacity to interpret and understand what the farm problems are and how to solve them. * * * There is a great waste of time now being spent on many subjects. The student is losing because he ought to be at work on subjects that can be learned only in a laboratory and with the guidance of an expert teacher. His time, however, is occupied usually with work of no scholastic grade, when he ought to expend his time in essential and fundamental courses.

Our now very complicated courses of agriculture do not give the results of the simpler courses of the older days. They are not turning out agricultural students of big, mental equipment but tending to serve on a plane no higher than mere trade information. In reform processes now going on in agriculture, reforming our college agricultural courses should have immediate consideration.

—*American Agriculturist.*

THE CULTIVATION OF ABACA AND PREPARATION OF ITS FIBER IN DAVAO[1]

By Vicente C. Aldaba
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One Text Figure

This article was written with the hope that it may be of help to abaca planters who are making an effort to improve their system of culture. It treats briefly of the methods and practices in connection with the cultivation and preparation of the fiber of abaca on some well-organized and prosperous plantations in the southwestern part of Davao. The writer had an opportunity to take part in the various operations and see the results. He attempted to discover the reasons for certain practices from two standpoints, the practical and the scientific.

In this paper when mention is not made of any operation in connection with the production of abaca, it is to be understood that the operation is similar to the one generally used.

VARIETIES

The number of varieties that may be found on the plantations in Davao, designated by local names, is not less than eight. In the southwestern part of the province, however, on a large majority of plantations only two varieties, namely, the Magindanao and the Boñgolanon are cultivated.

THE MAGINDANAO

This variety develops best in light clayey loam, coming to bearing in about three years. It produces soft white fiber which is easily extracted. The yield of fiber per hectare is heavy. The plant is easily injured by prolonged dry weather. The reason for this probably is that the root system is not developed sufficiently to be able to draw from the soil during dry weather an adequate amount of water for the rapid transpiration effected by the large leaves. The inadequately developed root system is doubtless responsible for the falling over of the stalks; a thing which often happens with no apparent cause other than that the roots are unable to hold up the big heavy stalks and leaves. The number of stalks to the hill is fairly large and they are not very close to each other.

THE BOÑGOLANON

This variety is superior to the Magindanao in many respects. It is rapidly gaining favor among the planters. Its most important advantage over the Magindanao is that it comes into bearing in two years; and in a soil favorable to it, as sandy loam, and with a little extra care, the first harvest can be made in about eighteen months. This means a great saving in weeding and also early financial returns. The Boñgolanon strips easier than the Magindanao, and the yield of fiber is heavier. Consequently, it costs less to produce fiber from this

[1] Experiment Station contribution, No. 65.

variety than from the Magindanao. For instance, in working a large stripping gang in a good stand of Magindanao the daily average per stripper is 11 kilograms of undried abaca of excellent cleaning. In a good stand of Boñgolanon the average is 13 kilograms.

Some of the advantages of the Boñgolanon over Magindanao are: It develops well on a greater range of soil and is more resistant to drought; the stalks are smaller and not so likely to fall on the ground; it stools better, and this helps to keep the grass from growing.

But the Boñgolanon variety has one serious defect. After about the sixth year the yield declines very fast. At the age of about ten or eleven years when the Magindanao still has a fairly good stand, the Boñgolanon is poor in yield; the stalks are small and comparatively short which of course means greater cost of extracting the fiber. This is probably due to its heavy stooling. At the age of four or five years the Boñgolanon field is very dark so that there is little chance for the development of the young shoots.

SOIL AND CLIMATE

The plantations are mostly along the Davao Gulf coast. The soil, generally, is deep alluvial deposit. Back of the plantations are mountain ridges which are responsible for the constant movement of underground water towards the seacoast. The movement of underground water is manifested by the numerous small streams which at places come to the surface.

The climate of the region is humid with a remarkably even distribution of rainfall. Most of the rain falls at night. As a rule, the day is clear and the night cloudy. Rain of two days' duration is very rare. Typhoons are unknown.

Table I is from the "Annual amount of distribution of rainfall in the Philippines", taken from the *Philippine Agricultural Review* and represents that of the town of Davao.

TABLE I.—*Monthly rainfall.*

Months.	*Amount.*	*Months.*	*Amount.*	*Months.*	*Amount.*
	mm.		*mm.*		*mm.*
January	110.2	May	252.8	September	203.6
February	141.6	June	234.2	October	242.3
March	164.2	July	208.9	November	176.4
April	190.3	August	207.4	December	208.8
TOTAL					2340.7 mm. a year.

The soil and climatic conditions, more than any other natural factors, are responsible for the excellent development of abaca in Davao. The virgin alluvial deposit is naturally rich and well drained. The even distribution of rainfall assures a constant supply of water to the abaca plant. With most of the rain falling at night leaving the days clear, transpiration and photosynthesis are unhindered. Add to these advantages the absence of typhoons and the combination is almost ideal for the growing of abaca.

ESTABLISHMENT OF THE PLANTATION

CLEARING

The clearing is done during the months of least rain, namely, January, February, March, and April. The felling of the trees takes place in January

and February and the burning in March and April, allowing six or more weeks for the cut growths to dry. In clearing the ground the undergrowth is first cut down, then follows the felling and trimming of the larger trees. No standing trees are left in the field. The branches are cut to pieces so as to produce a bed of trash as flat and close to the ground as possible. Then, when this is burned the fire burns slowly instead of in a blaze. This gives time for the twigs and small branches to become heated and catch fire. If the clearing is skillfully done, the burning is complete with the exception of the big branches, the trunks, and the stumps. To have to make a second burning requires the cutting and collecting of the unburned twigs, branches, and trunks into heaps before setting hem on fire. This operation consumes time and labor so is very uneconomical and means poor management. Also, it is likely to delay the planting of abaca.

DISTANCE

The cleared field is divided into blocks of 10,000 hills each. The distance between the hills is generally 2.74 meters (9 feet) in a square. The area of a block is therefore 7.50 hectares. The blocks are separated by cart roads 2.13 meters (7 feet) wide. Each block is given a name or number to facilitate the management.

Considering that abaca in Davao grows large and tall, this distance of 2.74 meters between the hills is close when compared with the recommendations of Edwards and Saleeby, which is from 2.9 to 3.5 meters. But the Davao plantation owners after a number of years of experience in abaca planting, stick to this distance. From the financial standpoint, as proven by experience, the practice is sound.

The question of distance with abaca is not so easy to determine as with other permanent crops, like the coconut, rubber, cacao, coffee, etc. In the case of the coconut, for example, the diameter of a fully developed crown may serve as the visible criterion for determining the distance. In Castilloa rubber, there is the question of making the tree form a certain shape and height of trunk, which necessitates, at first, a close planting. Then in order to give each good-sized tree ample light supply, some of the trees, after a certain number of years, are cut down. But in these cases there is only one plant standing in one place all the time. With abaca it is different. There is a number of plants in a hill and this number changes from time to time. After two or three years from the time of planting, from one to three stalks are cut away from each hill, but more stalks take the place of those that have been cut out. The next year several more stalks are cut away and still more have grown to take their places. In the same hill there may be from 15 to 30 plants varying in size from very small to nearly mature. The chance for development of each plant is less, the more there are in the hill, and the youngest plant has the least chance. These conditions naturally lead to the stunted development of the youngest plants. The fact that the yield from a unit area declines after a few years is thus partially explained.

Under these circumstances, it appears that experience is the only way to determine the best distance. Planters of experience point out that wide planting results in waste of space and high cost of upkeep.

Let us suppose that Boñgolanon is the variety planted and that the distance between the hills is 3.5 meters, instead of 2.74 meters. In general, if the

distance between the hills is 2.74 meters, it takes six weedings before the plantation comes into bearing. At ₱20 a thousand hills, the total cost of weeding until the abaca comes into bearing is ₱120. If the distance is 3.5 meters, the area occupied by each hill is 12.25 square meters instead of 7.51, as the case would be if the distance between the plants were 2.74 meters. Then the cost of weeding a thousand hills six times would be ₱195.74. But instead of weeding six times, in all probability weeding would have to be done seven times before the plantation comes into bearing. The total cost of weeding would be then ₱228.36, a difference for weeding alone of ₱108.36. In other words, it would cost nearly as much for weeding, to bring 1000 hills at 3.5 meters to bearing, as 2000 hills at 2.74 meters distance. Weeding is the heaviest expense in a young abaca plantation. The other operations would also be increased proportionately. Two thousand hills of abaca planted at a distance of 2.74 meters would yield almost two times the yield from 1000 hills planted 3.5 meters apart, both being properly taken care of. Furthermore, if for any reason the plantation becomes neglected, the close planting is likely to be less injured than the wide planting.

It thus appears that for Boñgolanon the distance of 2.74 meters is the better of the two. The distance generally adopted for Magindanao is 3.0 meters (10 feet).

LINING AND STAKING

Planting is done immediately or very soon after burning, for weeds begin to grow in a short time. Preparatory to planting, lines are laid off in the field inclosing squares the sides of which are equal to the intended distance between the hills. Stakes are then driven at each corner of the square.

SEED SELECTION

For seeds for planting, rhizomes over ten centimeters in diameter are used. The seeds are dug from an old plantation, taking a part of each hill. Here is a chance for selection. If, in general, seeds from prolific plants produce prolific plants, then it is only a matter of selecting and securing the best seeds from the best hills.

HOLING AND PLANTING

These two operations are performed simultaneously. Sharpened sticks are used to dig holes large enough to accommodate the seeds and deep enough to give a column of soil of about ten centimeters in height over the buried seed. The stalks and roots are cut off. The big seeds from the nearly mature stalks are cut into two or even four pieces, provided each piece has at least one visible eye. One piece is put in each hole. The stake is placed again to facilitate the location of vacancies for replanting.

REPLANTING

Replanting is done as soon as it can be ascertained which seeds failed to grow. This promptness is necessary for abaca grows very fast, and any delay in replanting results in a lack of uniformity of the stand. Moreover as the older plants shade the young low plants growing from replanted seeds, their growth is stunted when the plants are unequal in age. In connection with replanting it is well to remember that vacant hills do not only mean that much less crop but also grass. This is the more important reason for not neglecting replanting.

The writer watched the results of an extensive experiment in replanting with half mature abaca plants, including the stalk. The object was to have well grown plants that would not be shaded by the older plants. The experiment proved this kind of planting a failure. Not only did the stalk not recover in most cases, but the development of new suckers was hindered. The plants that recovered were not worth stripping. This fact emphasizes the necessity for early replanting.

CARE OF THE PLANTATION

WEEDING

Weeding is done about three months after planting and at about the same interval, thereafter. It is a good practice to clean a plantation as often as the supply of labor warrants it. One planter even went so far as to claim that cleaning every month is more economical than three or four times a year, if considered only from the standpoint of money saving. Also, with the monthly cleaning the plantation is always in a decent condition. Cleaning is done with a hoe. When labor is trained to handle the hoe, this implement is more effective than the bolo. The trash is piled between the rows when no catchcrop is to be planted. When corn is to be planted the pile is thrown in line with the rows, leaving the space between the rows free to plant two rows of corn.

CULTIVATION

Cleaning by hand is continued until all logs are decayed. Then cultivation is done with a plow. At the age of two years in the case of a field planted with the Boñgolanon variety, the ground is almost completely shaded, so gives very little chance for the weeds to grow. At this time the plantation is ready for light stripping and cleaning may be dispensed with for about a year. However, when the oldest mother stalks are cut away there is danger of weed invasion in the open spaces in the plantation. But by this time the logs are usually decayed and the cheaper and better cultivation with plow can be introduced. Hereafter, cultivation precedes the stripping, which takes place at long enough intervals to give time for the discarded portion of abaca sheaths to decay so as to let the plow pass through. A steel beam double shovel with blades about six inches wide is used. It is strong-built and light.

By this method complete cleaning of the ground of logs and stumps is not attempted. Besides the large saving in money, this practice is agronomically sound. In humid regions decomposition of organic matter is very rapid. In fact, in Mindanao, logs, with the exception of the large and hard-wood ones, are decayed, practically, in three or four years. Consequently the organic matter is incorporated in the soil as humus. No nitrogen is lost as is the case if the logs are burned. All the mineral fertilizer constituents are retained and the ground is maintained in good physical condition.

HARVESTING

From two to three years after planting, according to varieties, the first harvest may be made. Harvesting takes place every three or four months. Longer intervals result in a number of over-ripe and partly deteriorated stalks. The harvesters are trained men and their number depends on the number of strippers. As a rule, there is one harvester to every fifteen strippers. In addi-

tion to the cutting of the stalks, the harvesters collect in piles all the stalks left over by the strippers during the day. These stalks are of poor quality. The harvesters see that each stripper has turned to *tuxies* a pile of these stalks every morning before he goes to collect the newly cut stalks.

EXTRACTION OF FIBER

Each stripper makes his own *tuxies*. This is the first thing he does in the morning, making as much as he can strip during the day. He is not allowed to leave any *tuxy* unstripped over night.

CLASSIFICATION

The stripper separates the *tuxies* into three classes. Those from the first six to eight leaf-sheaths which yield entirely or partly discolored fiber are put into one class. The fiber extracted from this class constitutes the grades S_1 S_2 and S_3 of the Government classification. The fiber from the next ten to twelve inner leaf-sheaths is almost white, and constitutes the C, D, and E of the Government grades. The *tuxies* from these sheaths are put into another class. The third class of *tuxies* is from the remaining two to five innermost sheaths. The fiber from these sheaths is soft, white, and fine and constitutes the A and B of the Government grades. The A, B, and C becomes the AA, BB, and CC of the Japanese market, if they are over 2.13 meters (7 feet) long and are given a further treatment after stripping to make the fiber still cleaner and softer. On some plantations this is done by rubbing the fiber against the hand, and then combing it with the fingers thus making the fiber appear rather kinky, clean, and giving it a good luster.

THE STRIPPING APPARATUS

The stripping apparatus consists of two cross-pieces of wood, one vertical and one horizontal. The horizontal piece has the knife on one end and the weight on the other. It passes through a rectangular hole in the vertical piece in which there is a nail that serves as a fulcrum. The knife rests against a piece of bamboo when pressure is applied by means of the weight. The bamboo piece is fixed on the vertical. This apparatus is simple, capable of fine and quick adjustment, easy of transportation and easy to set. The knife is placed breast-high. Because of this position it utilizes the weight of the body, so that a less amount of physical exertion is required to strip a *tuxy* than by the apparatus in which the position of the knife is low. (See Figure 1.)

WEIGHING

The abaca stripped by each stripper during the day is weighed in the afternoon. This gives an opportunity for the overseer to examine closely the fiber of each stripper and to check the amount of work he has done for the day. On Monday morning the fiber stripped during the preceding week is weighed. At this time the fiber is well dried and put in good shape by the stripper so as to be ready for examination and baling. At this stage the fiber is closely examined for the quality and the final classification according to the plantation grades is made. Each hank of fiber is scrutinized and any one in which there is fiber not well cleaned or fiber of unnatural color is thrown into the lowest grades.

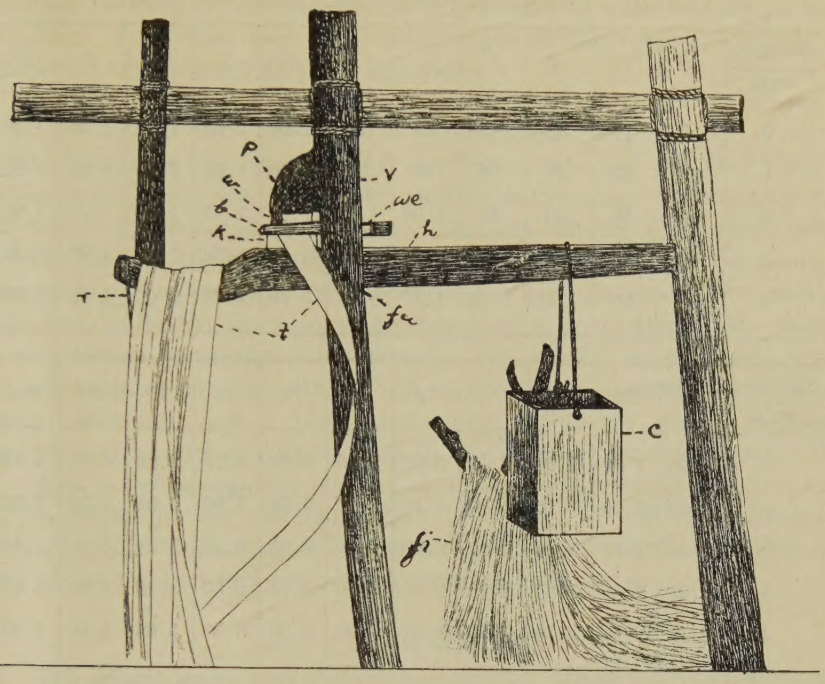

FIGURE 1.—*Showing construction of stripping apparatus.* *v*—Vertical piece of wood, with the base end driven into the ground. *h*—Horizontal piece of wood, passing through a hole in the vertical. *k*—Knife fixed on the horizontal. *b*—Piece of bamboo against which the blade of the knife rests. It is detachable. *w*—Piece of wood, detachable, held in place by the piece of bamboo and the projection *p* of the vertical. It serves to insure the contact between the piece of bamboo and the blade of the knife. *we*—A wedge-shaped small piece of wood to hold the piece of bamboo in place. *fu*—Nail serving as fulcrum. *c*—Petroleum can filled with soil. Pressure is regulated by moving the rope which holds the can along the horizontal. *r*—A small rope attached to a foot treadle, not shown in the picture. An opening is made between the knife and the piece of bamboo by stepping on the treadle. *t*—Tuxies. One is inserted between the knife and piece of bamboo ready to be pulled. *fi*—Cleaned abaca fiber.

COMPENSATION OF STRIPPERS

The strippers receive compensation for their work in terms of the dry weight of the fiber. As a rule 15 centavos is paid per kilogram of the discolored fiber, and 20 centavos per kilogram of the other two grades. The dry fiber turned in by the stripper must contain 25 per cent of the best grade. The difference in the payment per kilogram of the discolored and second grade fiber induces the stripper to get as much of the second grade fiber as possible. Weighing the best grade separately makes the stripper more careful in stripping the innermost sheaths so as to get the necessary quantity.

TABLE OF COMPENSATION FOR STRIPPER

In order to facilitate the calculation of the amount to be paid each stripper the writer constructed a table which he used when he was working on one of these plantations.

TABLE II.—*Form for calculating compensation for the strippers.*

Discolored / White	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
0	0	15	30	45	60	75	90	1.05	1.20	1.35	1.50
1	20	35	50	65	80	95	1.10	1.25	1.40	1.55	1.70
2	40	55	70	85	1.00	1.15	1.30	1.45	1.60	1.75	1.90
3	60	75	90	1.05	1.20	1.35	1.50	1.65	1.80	1.95	2.10
4	80	95	1.10	1.25	1.40	1.55	1.70	1.85	2.00	2.15	2.30

Discolored / White.	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*
0	1.65	1.80	1.95	2.10	2.25	2.40	2.55	2.70	2.85	3.00	3.15
1	1.85	2.00	2.15	2.30	2.45	2.60	2.75	2.90	3.05	3.20	3.35
2	2.05	2.20	2.35	2.50	2.65	2.80	2.95	3.10	3.25	3.40	3.55
3	2.25	2.40	2.55	2.70	2.85	3.00	3.15	3.30	3.45	3.60	3.75
4	2.45	2.60	2.75	2.90	3.05	3.20	3.35	3.50	3.65	3.80	3.95

The figure in the vertical column under white represents the number of kilograms of the two superior grades. In the record and in paying, those two grades are taken together. The figures along the top horizontal column represent the discolored fiber. It will be seen that the figures for the white are only up to and including 4. This is because every five kilograms of white is one peso and is easy to calculate mentally. Should the payment be other than 20 centavos a kilogram, the table can be extended downward. Beginning with figure 1 of the top horizontal column after every fifth number the line is doubled. This is to facilitate the location of the figures.

The method for finding the amount due each stripper is made plain by the following example: Suppose a stripper weighs 13 kilograms of the discolored fiber and 28 of the other grades. Then 28 = 25 + 3. The wage for 25 kilograms of the good grades at 20 centavos a kilogram is ₱5.00. Then running the eye from figure 3 in the column for the white toward the right until the figure which is in the vertical column below figure 13 of the horizontal column for the discolored is reached, the figure is 2.55 which is the wage for three kilograms of the good grades and 13 kilograms of the discolored fiber. This sum added to ₱5.00 gives ₱7.55 which is the amount due for stripping the 28 kilograms of the good grades and the 13 kilograms of the discolored fiber. This table saves time and prevents mistakes.

BALING

Baling is done with an apparatus consisting of a horizontal piece of board on the longitudinal edges of which are fixed, in such a way as to be movable, two vertical pieces of board. The abaca hanks are placed longitudinally in this apparatus, being doubled as many times as the length of the horizontal board requires. Care is taken that the hanks are not twisted. Pressure is

then applied, pressing the abaca as much as necessary to make it compact enough for handling. It is then tied with abaca ropes at four places. The finished bales generally weigh from 45 to 55 kilograms.

THE PLANTATION MARK

Each plantation has its own mark for each grade and the fiber from each plantation is known in the Philippine market by this mark. Each bale carries a mark which shows the plantation it is from and the grade to which it corresponds according to the plantation classification. This is a very cheap and very good means of advertising the fiber produced on a plantation. The plantation manager sees to it that the fiber shipped is always up to the mark. Once the abaca of a certain plantation is recognized in the market as good and honestly graded, that plantation can always sell its product at a good price. When a plantation does not have a recognized mark, merchants usually attempt to show all sorts of imaginary defects, so as to buy it at a lower price than it should bring. With a well-recognized plantation mark, which corresponds to a certain official classification, the merchants buy according to current quotation, so it is advantageous to have a well-recognized plantation mark. It helps in the disposal of the product and insures a reasonable price for it.

SUMMARY

1. The Magindanao and Boñgolanon are the abaca varieties most widely cultivated in southwestern part of Davao. Boñgolanon is rapidly becoming the favorite of the planters because it comes to bearing early, yields heavily, and is easy to strip.

2. The excellent development of abaca in Davao is due mainly to the remarkably even distribution and large amount of rainfall, the absence of typhoons, and the virgin soil composed of alluvial deposit.

3. A very wide distance between abaca hills is not advisable under present conditions in Davao; the upkeep is too expensive. Probably 2.74 meters with the Boñgolanon variety, and 3 meters with the Magindanao variety is about the best.

4. Planting and replanting should be done immediately after clearing. Replanting with well-grown plants including the stalk is not advisable.

5. Weeding with hoe as often as possible is a good policy in an abaca plantation. Cultivation with plow is done when all logs are decayed. This precedes the stripping of a field, which takes place when the discarded portion of abaca sheaths are already decayed and the plow can pass through.

6. The removal of logs and stumps from a new clearing is not advisable in Davao from either the money standpoint or the agronomical.

7. Harvesting is done every three or four months. Longer intervals result in a number of over-ripe and partly deteriorated stalks.

8. The classification of the *tuxies* is necessary as a preparation for the classification into different grades of the fiber.

9. The stripping apparatus as described in this paper is recommendable. It is simple, light, capable of quick and fine adjustment, and utilizes the weight of the stripper thus reducing the physical exertion necessary for stripping.

10. The difference in the wage for stripping the different grades promotes good work on the part of the stripper.

11. A table such as given in this paper, for paying the strippers, saves time and prevents mistakes.

12. Baling is done carefully so that the abaca hanks are not twisted.

13. Each plantation has its own mark. A well-recognized mark helps in the disposal of the plantation product and insures reasonable price for it. Each bale should bear a mark showing the quality of the fiber and the plantation it is from.

ILLUSTRATION

Figure 1.—Showing construction of stripping apparatus.

Science, in our century, is the soul of national prosperity and the living fountain of all progress! Of course, politics, with its vexatious daily questions, seems to be our guide—mere delusion! Our advance is due to certain scientific discoveries and their applications. *Pasteur.*

A STUDY OF THE NORMAL VARIATION IN FREQUENCY OF PULSE, RESPIRATION, AND TEMPERATURE OF THE CARABAO[1]

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The data used in this study were obtained by the class of 1923 of the College of Veterinary Science as an experiment in clinical diagnosis. Each reading was taken under the supervision of Faustino Turla, student assistant, and the writer. All extremes were checked by second readings.

Ten carabaos were selected from the herd of the College of Agriculture as subjects. In choosing these animals consideration was given to obtaining a wide variation in age, and nearly equal representation of the sexes.

These animals were handled under conditions as nearly normal as possible. During the day they were allowed to graze in a large well-watered and shaded pasture. At 2:00 p. m. they were driven by the herdsman into a small corral located on a wooded hillside of the range, in which was a supply of drinking water and a mud hole for wallowing.

On entering the corral each animal was tied to a tree with ropes, carried on their horns during the day. At 4:00 p. m. the readings were taken and the carabaos allowed the run of the corral for the night. The animals were again tied up at 6:00 a. m. by the herdsman and the readings taken at 7:00 a. m. The carabaos were then turned on to the range for the day.

To accustom the carabaos to this handling, the readings were not recorded for the first three days. The experiment continued for 20 days so that 400 readings each of temperature and frequency of respiration were obtained.

Because of the difficulty of palpating the pulse through the thick skin of the carabao, it was necessary to take the heart beat with a phonendoscope. The use of the phonendoscope excited the animals and caused so considerable a resistance that readings of pulse frequency were recorded only for the last seven days of the experiment, giving 140 readings.

Tables I-IV give the results of the experiment.

CONCLUSIONS

A study of Tables I to IV provides data as summarized in Table V.

From Table V the following conclusions may be set forth:

1. The averages are:
   - Frequency of pulse..... 40;
   - Frequency of respiration..... 24;
   - Temperature..... 38.33°C. or approximately 101°F.
2. In round figures the normal ranges are:
   - Frequency of pulse..... 30 to 55;
   - Frequency of respiration..... 15 to 45;
   - Temperature..... 37.5° to 39.°C.

[1] Experiment Station contribution No. 66.

3. Rainfall had little if any influence on the pulse, respiration and temperature. (Compare the readings of August 28 with September 9, and those of August 30 with August 31).

4. The daily temperature had a very noticeable influence. (See the readings of August 27, 30, and September 11).

5. Most of the afternoon readings were higher than those of the morning of the same day. This was modified by the temperature. (See the readings of August 29, 30, 31, and September 1).

6. The influence that the age of the animal had on its pulse, respiration, and temperature is shown by the readings of carabao Number 7 which had the highest pulse frequency and temperature of the carabaos.

7. No appreciable influence due to sex is noticeable in the readings.

TABLE I.—*Showing extremes of pulse, respiration, and temperature for each carabao.*

No.	Age.		Sex.	Frequency of pulse.			Frequency of respiration.			Temperature °C.		
	Year.	Month.		A. M.	P. M.	Daily.	A. M.	P. M.	Daily.	A. M.	P. M.	Daily.
1	12	9	M	29–41	36–50	29–50	**13**–34	**16**–48	**13**–48	**37.00**—38.50	37.65—38.90	37.00—38.90
2	10	3	F	30–45	33–**70**	30–**70**	16–45	18–60	16–60	37.20—38.70	37.90—40.00	37.20—40.00
3	3	9	M	32–42	35–54	32–54	17–32	22–55	17–55	37.90—38.80	37.75—39.80	37.75—39.80
4	10	5	F	28–43	32–55	28–55	15–36	17–43	15–43	**37.00**—38.50	37.20—38.90	37.00—38.90
5	15	3	F	28–41	32–53	28–53	**13**–34	18–48	**13**–48	37.30—38.65	**36.85**—39.60	**36**.85—39.60
6	4	2	F	29–42	**31**–54	29–54	**13**–44	19–56	**13**–56	37.20—38.50	37.35—39.80	37.20—39.80
7		11	M	35–**48**	35–63	35–63	14–28	18–**76**	14–**76**	37.10—38.80	38.10—**40.60**	37.10—**40.60**
8	3	11	F	33–40	36–51	33–51	16–28	18–40	16–40	**37.00**—38.65	37.80—39.35	37.00—39.90
9	10	10	M	**26**–39	35–43	**26**–43	14–**60**	17–42	14–60	37.45—38.80	37.20—39.40	37.20—39.40
10	2	9	F	34–43	38–54	34–54	15–24	17–34	15–34	37.90—**38.90**	37.75—39.20	37.75—39.20
Average				30–42	34–55	30–55	15–36	18–50	15–52	37.30—38.68	37.56—39.55	37.20—39.81

TABLE II.—*Showing extremes of pulse, respiration, and temperature for each day.*

Date.	Mean daily temperature °C.	Rainfall in mm.	Frequency of pulse.			Frequency of respiration.			Temperature in °C.		
			A. M.	P. M.	Daily.	A. M.	P. M.	Daily.	A. M.	P. M.	Daily.
Aug.											
23	27.1	2.8					20–56			38.15—38.95	
24	26.0	O				22–**60**	19–42	19–60	37.45—38.50	38.15—39.00	37.45—39.00
25	26.1	T				16–36	20–60	16–60	37.55—38.55	38.40—40.00	37.55—40.00
26	26.6	O				16–44	26–54	16–54	37.70—38.70	38.30—39.30	37.70—39.30
27	27.5	T				20–32	26–50	20–50	37.80—38.80	38.60—39.80	37.80—39.80
28	25.8	36.6				18–30	19–26	18–30	37.80—**38.90**	38.20—38.95	37.80—38.95
29	25.7	4.6				18–40	18–29	18–40	37.95—38.50	37.60—38.80	37.60—38.80
30	24.8	1.7				18–28	18–37	18–37	37.60—38.50	**36.85**—38.60	**36.85**—38.60
31	24.4	12.5				20–30	20–24	20–30	37.70—38.70	37.45—39.20	37.45—39.20
Sept.											
1	25.4	6.8				16–24	20–25	16–25	**37.00**—38.80	37.50—39.20	37.00—39.20
2	26.2	28.6				18–26	18–45	18–45	37.80—38.45	37.20—39.10	37.20—39.10
3	25.7	T				16–24	19–27	16–27	37.80—38.40	38.10—39.20	37.80—39.20
4	25.6	T				16–24	20–26	16–26	37.80—38.60	37.90—38.70	37.80—38.70
5	25.2	2.6		32–53		16–25	17–27	16–27	37.80—38.50	38.30—39.80	37.80—39.80
6	25.6	9	27–42	**31**–53	27–53	14–20	**16**–26	14–26	37.20—38.40	38.40—38.80	37.20—38.80
7	25.7	O	28–43	36–**70**	28–**70**	14–17	20–**76**	14–**76**	**37.00**—38.00	38.60—**40.60**	37.00—**40.60**
8	25.2	16.2	28–48	43–69	28–69	**13**–24	20–26	**13**–26	**37.00**—38.20	38.50—39.80	37.00—39.80
9	25.9	5	29–45	35–54	29–54	15–26	19–53	15–53	37.90—38.65	38.40—39.20	37.90—39.20
10	26.5	O	28–42	35–49	28–49	**13**–45	17–37	**13**–45	37.80—38.60	38.30—38.80	37.80—38.80
11	24.9	27.0	**26**–44	39–47	**26**–47	**13**–21	17–26	**13**–26	37.10—38.40	38.30—38.90	37.10—38.90
12	26.0	.5	35.43			**13**–24			37.80—38.65		
Averages.			29–44	35–56	28–57	16–30	19–39	15–38	37.58—38.55	38.11—39.23	37.49—38.79

TABLE III.—*Showing averages of pulse, respiration, and temperature for each carabao.*

No.	Age.		Sex.	Frequency of pulse.			Frequency of respiration.			Temperature in °C.		
	Yr.	Mo.		A.M.	P.M.	Daily.	A.M.	P.M.	Daily.	A.M.	P.M.	Daily.
1	12	9	M	34	43	38	19	25	22	38.02	38.46	38.24
2	10	3	F	38	51	44	25	28	26	38.13	38.80	38.46
3	3	9	M	35	46	40	24	31	27	38.24	38.64	38.44
4	10	5	F	36	43	39	22	23	22	37.92	38.23	38.07
5	15	3	F	34	44	39	23	27	25	38.08	38.67	38.37
6	4	2	F	36	43	39	21	29	25	38.01	38.61	38.31
7		11	M	41	50	45	20	26	23	38.13	38.84	38.48
8	3	11	F	36	45	40	21	23	22	38.05	38.53	38.29
9	10	10	M	30	38	34	24	26	25	38.04	38.45	38.24
10	2	9	F	38	46	42	19	23	21	38.31	38.52	38.41
Averages.....				36	45	40	22	26	24	38.09	38.57	38.33

TABLE IV.—*Showing averages of pulse, respiration, and temperature for each day.*

Date.	Mean daily temperature. °C.	Rainfall in mm.	Frequency of pulse.			Frequency of respiration.			Temperature in °C.		
			A.M.	P.M.	Daily.	A.M.	P.M.	Daily.	A.M.	P.M.	Daily.
Aug.											
23	27.1	2.8					41			38.50	
24	26.0	O				33	24	29	38.15	38.53	38.34
25	26.1	T				28	37	32	38.25	38.89	38.57
26	26.6	O				27	33	30	38.21	38.70	38.46
27	27.5	T				26	33	29	38.26	39.04	38.68
28	25.8	36.6				24	21	22	38.31	38.45	38.38
29	25.7	4.6				23	22	23	38.22	38.17	38.20
30	24.8	1.7				22	23	23	38.18	37.81	38.00
31	24.4	12.5				24	22	23	38.22	38.21	38.22
Sept.											
1	25.4	6.8				21	22	21	37.71	38.30	38.01
2	26.2	28.6				22	25	24	38.12	38.42	38.28
3	25.7	T				19	22	21	38.04	38.58	38.31
4	25.6	T				20	23	21	38.16	38.38	38.27
5	25.2	2.6		40		21	21	21	38.22	38.98	38.60
6	25.6	.9	35	39	37	16	21	19	37.84	38.55	38.20
7	25.7	0.	36	50	43	15	35	25	37.58	39.10	38.40
8	25.2	16.2	35	52	43	16	22	19	37.69	38.81	38.25
9	25.9	.5	36	46	41	21	26	23	38.30	38.83	38.57
10	26.5	0.	35	43	39	22	28	25	38.12	38.55	38.31
11	24.9	27.0	35	42	38	17	20	19	37.79	38.58	38.17
12	26.0	.5	40			18			38.26		
Averages			36	45	40	22	26	24	38.09	38.57	38.33

TABLE V.—*Summary of Tables I, II, III, and IV*

Table.	Item.	Frequency of pulse.			Frequency of respiration.			Temperature °C.		
		A. M.	P. M.	Daily.	A. M.	P. M.	Daily.	A. M.	P. M.	Daily.
I	Extremes for all carabaos	26–48	31–70	26–70	13–60	16–76	13–76	37.00—38.90	36.85—40.60	36.85—40.60
II	Extremes for all days	26–48	31–70	26–70	13–60	16–76	13–76	37.00—38.90	36.85—40.60	36.85—40.60
I	Average extremes for all carabaos	30–42	34–55	30–55	15–36	18–50	15–52	37.30—38.68	37.56—39.55	37.20—39.81
II	Average extremes for all days	29–44	35–56	28–57	16–30	19–39	15–38	37.58—38.55	38.11—39.23	37.49—38.79
	Average extremes for all carabaos for all days	29–43	34–55	29–56	15–33	18–44	15–45	37.44—38.61	37.83—39.39	37.34—39.30
III	General average for all carabaos	36	45	40	22	26	24	38.09	38.57	38.33
IV	General average for all days	36	45	40	22	26	24	38.09	38.57	38.33

PEDIGREE SELECTION WITH NATIVE YELLOW FLINT CORN[1]

By Lorenzo Goco

INTRODUCTION

The average yield of corn per hectare in the Philippines is but 857 kilograms (14.7 cavans) of shelled corn[2]; this is only about one half of the average yield of corn per hectare in the United States[3]. This comparatively low yield emphasizes the necessity, in the Islands, of producing seeds with high yielding power.

REVIEW OF LITERATURE

There are several methods of pedigree selection of corn which may be briefly described as follows:

Ear-row system not accompanied by detasseling.—A given number of rows are planted, each row being planted with seeds from one selected ear. At harvest, the yield is weighed row by row. The seeds for the next planting are selected from the highest yielding rows only. This method has given increased yield of corn. Evidence in support of this may be cited: Hume (1) in 1919, presented data obtained with this method of corn breeding. The average yield for seven years of the highest yielding rows out-yielded the lowest yielding ones by 25.9 bushels, the check rows by 15.1 bushels, and the average of all the rows by 12.7 bushels per acre.

Hartley (2) in his investigations on corn states that "seed ears taken from the highest yielding rows of ear-to-row breeding plots have repeatedly produced better than seed ears taken from poorer yielding rows. Seed ears from the highest yielding stalks found in a general field produced better than equally large and good-appearing seed ears taken without considering the inherent productiveness of the parent stalks."

The objection to this method is that inbreeding is not prevented.

Ear-row system accompanied by detasseling alternate rows.—This method is similar to the first one except that all odd-numbered rows are completely detasseled and seeds for the next planting are selected only from the highest yielding detasseled rows. In connection with this method of corn breeding, Elayda (3) states that the chief advantage is that the inbreeding is much reduced and that the seeds to be used for multiplication come only from hybridized plants. The chief objection, however, as is pointed out by him, is that the best yielding row might, by chance, be between poor yielding ones or it might be among those which are left with their tassels.

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[1] Thesis presented for graduation from the College of Agriculture, No. 131; Experiment Station contribution No. 67.

[2] According to Statistical Bulletin No. 2 of the Philippine Bureau of Commerce and Industry, the average of five average yearly productions of shelled corn since 1914 is 857 kilograms per hectare.

[3] According to Farmers' Bulletin No. 1175, the average production of corn in the United States is 26 bushels of shelled corn per acre or approximately 1654 kilograms per hectare.

Quartering method.—This method is described by Elayda (3) as follows:

> The ears selected are planted separately. Superior ears are selected from each row. The breeding plot is then divided into four quarters. One half of the number of ears selected in the first quarter is alternated with one half of the number of ears in the fourth; one half of the number of the second is alternated with one half of the number of the third quarter; the remaining half of the ears of the third quarter is alternated with the remaining half of the fourth quarter and the remaining half of the ears of the first quarter is alternated with the remaining half of the second. The alternate rows are detasseled to serve as sources of seeds, and the process is continued, always saving and always retaining seeds from each of the four quarters. This method allows a wide range of combination and inbreeding is reduced.

With this system of breeding, Hume (1) found that the highest average yield exceeded the lowest by 23.6 bushels and the general average yield by 11.8 bushels per acre.

Smith (4), after ten generations with this method of corn breeding, was able to produce from a single variety two strains of corn, one being nearly twice as rich in protein as the other. Similarly, in another experiment he produced two different strains, one producing almost three times as much oil as the other.

Ear-row system accompanied by detasseling, alternating halves of breeding rows.—As with the quartering method, the selected ears are planted ear-to-the-row. In order to insure cross fertilization, the alternating halves of the breeding rows are detasseled. At maturity the corn is harvested and the yield of each row weighed separately. The seeds for the next planting are selected from the detasseled plants of the highest yielding rows. This method considerably reduces inbreeding. The chief advantage of this method is that each row is given an absolutely even chance with every other row.

In the Philippines, steps have recently been taken by the Bureau of Agriculture to produce improved corn seeds by pedigree selection.

Paulican's 1920 report on the work of the Cotabato Seed Station shows pedigree selection of corn begun in July, 1920. At present the Station has plantings of seeds from selected superior breeding rows (5).

The La Carlota Experiment Station has been conducting ear-row tests of corn since 1917 (6). In this test the alternating halves of every row are detasseled. No conclusive result has yet been reported.

So far as the writer knows, the work reported in this paper is the first effort made to improve corn seed by pedigree selection in the College of Agriculture.

OBJECT OF THE PRESENT WORK

The present work is a beginning of a series of experiments the ultimate end of which is the isolation of high-yielding strains of the Native Yellow Flint corn.

TIME AND PLACE OF THE PRESENT WORK

This study was begun in December, 1919, and closed in March, 1921. It was carried out on the Experiment Station ground of the College of Agriculture, University of the Philippines.

MATERIALS AND METHODS

THE SEED EARS

Two hundred and ten ears of Native Yellow Flint corn from Calauang, Laguna, were used to begin the experiments. These ears were given register numbers; were shelled and the grains placed in paper bags. The numbers are from 101 ro 305, skipping the even 10s to provide for checks as will be explained later. The advantage of beginning the register numbers at 101 is that every ear will have an equal number of figures which later will help in numbering the seed ears for other plantings.

The check was a uniform lot of seeds obtained by mixing thoroughly seeds from 25 ears taken from the 210 ears from Calauang. Ears of plants from these seeds were mixed and considered the check seed material for the following check cultures.

FIRST PLANTING

The preliminary ear-row test.—The Agronomy Department prepared the field. The field was divided into halves across the rows. The rows of the first half were numbered 0, 1, 2, 3, etc, up to 100, while those of the second half were numbered 0, 101, 102, 103, etc., up to 206. The seeds from the paper bags were planted in such a way that rows numbered 1, 2, 3, 4 were planted with seeds from ears 101, 102, 103, 104 and so on.

Three seeds were planted in each hill and the plants were thinned to two while still young so as to give them the full benefit of the space necessary for their proper development. The distance between the hills was 75 centimeters and the rows were 75 centimeters apart.

Check rows.—Every tenth row starting with Number 0 and continuing with the rows 10, 20, 30, 40 and so on was planted with seeds from the check stock. The last row of the field was also a check.

The object of the check was to minimize the experimental errors due to non-uniformity of the soil.

The plants were given the ordinary care and cultivation until maturing and harvesting time.

Harvest.—At harvest, the plants in each row were counted and the yield determined.

The actual yield per plant was found by dividing the weight of the yield per row by the number of plants in that row. Because of the difference in soil fertility of different parts of the field the comparison of the yield of different rows was made on the basis of probable, or theoretical yield had the soil been uniform.

The method employed in the calculations of the theoretical yield is the same as that used by Lontoc (7).

This is made clearer by Table I.

TABLE I.—*A sample of results showing the actual and theoretical yields per plant.*

Row number.	Register number.	Number of plants in the row.	Actual yield per row.	Actual yield per plant.	Theoretical check yield per plant of non-check rows.	Difference between the actual yield of non-check rows and the theoretical yield of check in these rows.		Theoretical average yield of check rows.	Theoretical yield per plant of non-check rows.
						+	—		
			kg.	*gm.*	*gm.*	*gm.*	*gm.*	*gm.*	*gm.*
0	check	55	2.8	50.91	50.91	— —	— —	——	——
1	101	46	1.7	36.96	51.68	——	14.72	——	40.04
2	102	67	3.8	56.72	52.45	4.27	——	——	59.03
3	103	51	2.4	47.06	53.22	——	6.16	——	48.60
4	104	62	2.1	33.87	53.99	——	20.12	——	34.64
5	105	78	3.1	38.46	54.76	——	16.30	54.76	38.46
6	106	55	3.3	60.00	55.53	4.47	——	——	59.23
7	107	61	5.7	93.44	56.30	37.14	——	——	91.90
8	108	69	5.6	81.16	57.07	24.09	——	——	78.85
9	109	74	5.4	72.97	57.84	15.13	——	——	69.89
10	check	70	4.1	58.57	58.57	——	— —	— —	——

The theoretical check yield of non-check rows was determined in the following manner: Check Row 0 yielded 50.91 grams per plant, and Check Row 10 yielded 58.57 grams per plant. There is then a probable rise in soil fertility from Check Row 0 to Check Row 10, and non-check rows where ears 101, 102, 103, and so on up to where ear 109 was planted were involved in this soil variation. The difference between Check Row 0 and Check Row 10, divided by 10, and the resulting quotient added to the yield per plant of Check Row 0 or to the smaller number of the two, will give the theoretical check yield for the non-check row where ear 101 was planted. Then adding again the resulting quotient to the theoretical check yield just found will give the theoretical check yield of the non-check row where ear 102 was planted. The same method was used in finding the theoretical check yield of other non-check rows. For the rest of the explanation of this method, the following quotations from Lontoc's thesis are given:

> The difference between the actual yield of a non-check row and the theoretical yield of check in this row was found and designated as minus or plus; minus, if the theoretical yield of the non-check row was greater than the actual yield, and, plus, if the actual yield was greater than the theoretical check yield.
>
> The theoretical average yield of the check row was determined by adding the actual and theoretical check yields and dividing the sum by the number of figures added.
>
> The theoretical non-check yield per plant of non-check row was found by adding or subtracting from the theoretical average yield of the check row, the difference between actual yield of non-check rows and theoretical yield of check in these rows; subtracted, if the difference was preceded by a minus sign and added if preceded by plus sign.

Fifty best-yielding rows were selected as source of seeds for the second ear-row tests.

SECOND PLANTING

Seeds.—From each best-yielding row selected from the preliminary ear-row test given above, four ears were selected for seed in this culture. These ears were numbered 10701, 10702, 10703, and 10704. The cipher for the fourth

digit to the right in each number was used to enable one to tell what the register number of the mother ear was in the first planting. The number of generations an ear was carried on can also be determined by adding one generation to the number of figures at the right of this cipher. Thus an ear with register number 11101 indicates that the mother ear was 111 and that this ear is in its second generation. With register number 111012, the mother ear was 111 and it is in its third generation. This method of numbering helps in the prevention of planting the sister ears near one another. This is done by not planting in adjacent rows ears of which the first three columns of the register numbers are the same.

The field was divided in exactly the same way and check was planted in rows at the same intervals as in the first planting.

The first half of the field was planted with selected ears from the first 25 rows and the second half of the field with selected ears from the other 25 rows selected from the first test. The four sister ears from each row were planted separately at intervals of every 25 non-check rows. In this way inbreeding was reduced.

The plants in this test were given exactly the same distancing and cultivation as those in the first.

Detasseling.—The alternating halves of the breeding rows were detasseled before the pollen matured in order to prevent self-pollination or close-pollination. "Self-pollination" is the fertilization of the female flower of a given plant by the pollen of the same plant. "Close-pollination" is the fertilization of a female flower of one plant by the pollen from another plant in the same row both of which grew from seeds of the same mother ear.

The check rows and all inferior plants everywhere in the plot were detasseled to prevent undesirable crosses with the breeding rows.

Detasseling was done by going over the rows daily for several days during the tasseling period and carefully pulling off the tassels as they came out of the last leaf. In this experiment two weeks were devoted to this work. Great care was exercised not to include the youngest leaf with the tassel in pulling, as it was observed that at this stage this portion of the corn plant is very tender and even with a slight jerk upward the stalk may break at the second joint above and deprive the plant of one leaf.

The accompanying diagram will help to show the detasseled and undetasseled ends. It will be found here that the second half of Row 11 was detasseled instead of the first half as was done in Row 1. The object of this was to avoid having three successive detasseled ends which otherwise would occur, since the first half of Row 9 and the entire check row next to it were already detasseled.

Harvest.—Before harvesting, ten ears were marked in the detasseled end of each breeding row. Care was taken not to select any ear from plants within the fifth hill from the last tasseling plant in this row. This was to prevent the selection of ears which were close-fertilized.

At harvest, the plants in the tasseled and detasseled ends of each row were counted and the yield weighed separately row by row.

The theoretical yield per plant was computed in the same manner as that followed for the first planting.

A diagram of part of the field showing the detasseled and undetasseled ends.

Row Number		
0	(Check) completely detasseled	
1	detasseled	undetasseled
2	undetasseled	detasseled
3	detasseled	undetasseled
4	undetasseled	detasseled
5	detasseled	undetasseled
6	undetasseled	detasseled
7	detasseled	undetasseled
8	undetasseled	detasseled
9	detasseled	undetasseled
10	(Check) completely detasseled	
11	undetasseled	detasseled
12	detasseled	undetasseled
13	undetasseled	detasseled
14	detasseled	undetasseled
15	undetasseled	detasseled
16	detasseled	undetasseled
17	undetasseled	detasseled
18	detasseled	undetasseled
19	undetasseled	detasseled
20	(Check) completely detasseled	

The crop constituting the second planting was much damaged by unfavorable weather conditions. When the plants were about 30 centimeters high, heavy rains fell and flooded the entire field. Then during the tasseling period heavy rains and strong winds destroyed a number of plants. However, fair harvest was obtained.

RESULTS

Table II shows the relation of the highest yielding ear to the lowest yielding ear, to the average ear, and to the check.

Table III shows the performance of the 50 best ears in the preliminary ear-row tests.

Table IV shows the superiority of detasseled plants over tasseled ones.

Table V shows the relations of the highest yielding ear to the lowest yielding one, to the average ear, and to the check in the second planting.

Table VI gives the yield of 50 best rows in the second breeding ear-row test.[4]

[4] Full tables showing (1) *Results of the preliminary ear-row tests.* (2) *Yield of undetasseled ends from the second ear-row breeding plot.* (3) *Yield of detasseled ends from the second ear-row breeding plot.* (4) *Total yield of individual rows from the second ear-row breeding plot,* are omitted because of lack of space. These tables are on file in Agronomy Department, College of Agriculture. Copies will be sent to any one who may desire them.

TABLE II.—*Comparison of (1) the theoretical yield per plant of highest yielding ear, (2) the average theoretical yield per plant of all ears tested, (3) the theoretical yield per plant of the lowest yielding ear and (4) the average theoretical check yield per plant in the first planting.*

	grams
Theoretical yield per plant of highest yielding ear	95.37
Average of theoretical yield per plant of all ears tested	55.66
Theoretical yield per plant of lowest yielding ear	13.38
Average of theoretical check yield per plant	55.72
Number of grams by which highest yielding ear exceeds the average	39.71
Number of grams by which highest yielding ear exceeds the lowest	81.99
Number of grams by which highest yielding ear exceeds the check	39.65

TABLE III.—*Results of the preliminary ear-row tests showing the 50 best rows.*

Row number.	Register number.	Actual yield.	Actual yield per plant.	Theoretical yield per plant of non-check rows.	Row number.	Register number.	Actual yield.	Actual yield per plant.	Theoretical yield per plant of non-check rows.
		kg.	*gm.*	*gm.*			*kg.*	*gm.*	*gm.*
7	107	5.7	93.44	91.90	151	251	6.0	75.95	85.23
8	108	5.6	81.16	78.85	152	252	4.6	61.33	68.29
9	109	5.4	72.97	69.89	154	254	5.8	78.38	80.70
11	111	5.6	80.00	73.00	155	255	5.4	65.06	65.06
13	113	3.8	86.36	82.86	156	256	6.2	80.52	78.20
14	114	4.8	67.66	65.91	157	257	5.0	70.42	65.78
18	118	7.3	90.12	95.37	166	266	5.5	68.75	68.82
21	121	4.7	65.29	75.52	175	275	4.5	70.31	70.31
22	122	4.7	60.26	67.94	176	276	6.2	76.54	77.09
43	143	6.5	75.58	72.84	177	277	5.7	71.25	72.35
45	145	3.8	65.52	65.52	179	279	5.7	72.15	74.35
51	151	4.35	62.14	66.18	181	281	5.2	58.43	69.03
52	152	4.65	63.70	66.73	182	282	4.7	59.49	67.44
54	154	4.7	79.66	80.67	183	283	5.8	66.67	71.97
66	166	5.3	67.09	68.86	184	284	5.7	73.08	75.73
69	169	2.7	65.85	72.93	185	285	6.4	73.56	73.56
89	189	4.4	62.86	67.10	187	287	6.3	76.83	71.53
111	211	4.9	70.01	75.49	193	293	6.0	69.77	68.27
127	227	5.1	60.00	65.58	194	294	5.3	67.09	66.34
128	228	4.5	57.69	66.06	195	295	6.8	90.67	90.67
129	229	4.9	60.49	71.65	198	298	6.2	87.32	89.57
134	234	5.8	65.91	67.03	204	304	4.7	66.20	70.33
144	244	6.4	67.37	66.23	205	305	4.5	66.18	74.44
145	245	5.7	69.51	69.51					
146	246	5.7	77.02	78.16	TOTAL				3658.54
147	247	5.1	69.86	72.14	AVERAGE				73.17
149	249	5.2	65.00	69.56					

TABLE IV.—*Comparison of (1) the average theoretical yield per plant of detasseled ends, (2) the average theoretical yield per plant of undetasseled ends and, (3) the average theoretical check yield per plant.*

	grams
Average theoretical yield per plant of detasseled ends	72.11
Average theoretical yield per plant of tasseled ends	69.15
Average theoretical check yield per plant	66.32
Number of grams by which detasseled portions exceeded tasseled portions per plant	2.96
Number of grams by which detasseled portions exceeded check portions per plant	5.79
Number of grams by which tasseled portions exceeded check portions per plant	2.83

TABLE V.—*Comparison of (1) the theoretical yield per plant of highest yielding ear, (2) the average theoretical yield per plant of all ears tested, (3) the theoretical yield per plant of lowest yielding ear and (4) the average theoretical check yield per plant in the second planting.*

	grams
Theoretical yield per plant of highest yielding ear	94.87
Average of theoretical yields per plant of all ears tested	70.95
Theoretical yield per plant of lowest yielding ear	35.17
Average of theoretical check yields per plant	66.32
Number of grams by which highest ear exceeded the average	23.92
Number of grams by which highest ear exceeded the lowest	59.70
Number of grams by which highest ear exceeded the check	28.55
Number of grams by which average ear exceeded the check	4.63

TABLE VI.—*Result of the second ear-row tests with alternate ends of rows detasseled showing 50 best rows.*

Row number.	Register number.	Actual yield.	Actual yield per plant.	Theoretical yield per plant of non-check rows.	Row number.	Register number.	Actual yield.	Actual yield per plant.	Theoretical yield per plant of non-check rows.
		kg.	*gm.*	*gm.*			*kg.*	*gm.*	*gm.*
23	22901	8.1	77.88	83.60	98	15404	7.00	81.40	83.53
35	11802	7.85	85.33	85.33	142	25102	6.6	84.62	85.97
38	14302	11.9	91.54	91.99	149	27502	7.05	87.04	85.24
41	15102	12.20	81.21	81.49	164	29802	7.6	85.39	83.91
42	15202	8.85	81.94	82.15	167	24703	7.6	80.85	83.81
45	16902	7.85	85.33	85.33	168	24903	8.5	90.43	94.87
46	18902	13.20	93.62	93.55	169	25103	6.3	81.82	87.74
47	21102	10.80	92.37	92.23	172	25403	8.05	90.45	93.81
49	22802	9.70	82.91	82.63	173	25503	5.0	78.13	80.37
55	24602	11.00	82.09	82.09	174	25603	6.8	91.89	93.01
56	10703	11.85	89.77	90.03	177	27503	6.8	94.44	92.20
57	10803	11.40	89.06	89.58	182	28103	7.25	88.41	89.70
58	10903	10.00	83.33	84.00	183	28203	7.3	79.35	80.21
63	11803	5.6	88.89	86.93	187	28703	4.4	84.62	83.76
64	12103	4.8	82.76	81.78	188	29303	5.2	83.87	82.58
65	12203	10.80	87.09	87.09	191	29503	4.35	85.29	88.37
71	15403	6.8	86.08	83.44	192	29803	2.4	80.00	82.31
77	22803	8.75	79.55	80.87	194	30503	4.15	81.37	82.14
78	22903	7.00	81.40	83.38	197	25104	7.25	88.41	86.87
81	24403	7.60	77.55	82.87	202	25604	5.4	81.82	81.58
82	24503	9.30	76.23	80.22	206	27604	5.6	84.85	84.93
84	10704	7.05	84.94	86.27	208	27904	5.1	80.95	81.19
85	10804	7.3	83.91	83.91	211	28204	3.4	82.93	80.45
88	11304	7.05	84.94	80.95	213	28404	3.9	88.64	87.40
91	11804	5.95	83.80	80.96	TOTAL				4263.61
94	14304	5.05	85.59	84.88	AVERAGE				85.27

DISCUSSION OF RESULTS

FIRST PLANTING

There was a wide range of variation in the productive power of individual ears, ranging from 13.38 grams to 95.37 grams per plant.

The variation in the yield of the check rows indicated non-uniformity of the soil in the field.

The theoretical yields are summarized in Table II. From this table it may be observed that the highest yielding ear out-yielded the lowest yielding one by 81.99 grams per plant, the average of all ears tested by 39.71 grams per plant, and the check by 39.65 grams per plant.

SECOND PLANTING

In Table IV, the direct effect of detasseling is shown by an average increase in yield per plant of 2.96 grams over undetasseled plants and 5.79 grams over the check. The difference between the yield of the tasseled plants and the yield of the check demonstrated that even without detasseling an increase of 2.83 grams per plant was obtained by the use of selected seed ears.

Table V shows that the highest yielding ear taken from the 50 best rows in the first breeding plot and planted in the second, exceeded the lowest by 59.7 grams, the average by 23.92 grams, and the check by 28.55 grams a plant. Also the average of all rows tested exceeded the check by 4.63 grams a plant.

The difference of 59.7 grams a plant between the yields of the two extremes shows that the range of variation in the second planting is much narrower than the range of variation in the first.

In Table III it may be observed that ear 118 was the highest yielder while in the second planting it did not appear to be so; however, out of its four daughter ears used in the second planting, three are among the 50 best yielders as is shown in Table VI.

The results of the first and second plantings are summarized in Table VII.

TABLE VII.—*Summary of results of first and second plantings.*

	First planting.	Second planting.	Differences.
	gm.	*gm.*	*gm.*
Theoretical yield per plant of highest yielding ear.	95.37	94.87	— .50
Average theoretical yield per plant of all breeding rows.	55.66	70.95	+15.29
Theoretical yield per plant of lowest yielding ear.	13.38	35.17	+21.79
Average theoretical yield per plant of 50 best rows selected. .	73.17	85.27	+12.10

It will be observed in Table VII that there was a difference of 0.5 grams in favor of the first planting between the yields per plant of the two highest yielding ears. This was probably due to the adverse climatic conditions met by the plants during the silking period in the latter test. However, all the other comparisons favor the second breeding test. In the second test, the average theoretical yield of all breeding rows, the theoretical yield of the lowest yielding ear, and the average theoretical yield of 50 selected rows exceeded those of the first planting by 15.29 grams, 21.79 grams, and by 12.1 grams per plant respectively.

SUMMARY OF CONCLUSIONS

1. Different ears of Native Yellow Flint corn have different yielding power.
2. The average theoretical yield per plant of all breeding rows in the second planting exceeded the check by 4.63 grams (Table V).

ACKNOWLEDGMENT

The writer wishes to express his thanks to Dr. Nemesio B. Mendiola, of the Department of Agronomy, for his valuable suggestions and advice during the progress of the work and to Prof. Inocencio Elayda for his criticisms.

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EFFECT ON BANANA FRUIT OF PREMATURE APPEARANCE OF THE INFLORESCENCE[1]

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Of the Department of Agronomy

ONE PLATE

I here record what seems to me a curious case of premature appearance from the stalk of banana flowers and the effect on the size of the fruit and of the bunch.

During one of the storms of the past months, a banana plant of the Latundal or Katungal variety, located in the yard back of the house where I am living, was broken at the top of the stalk a little below the point where the leaves unite to form the false stem. It was probable that as a result of the bending of the top portion of the plant a small crack was made in the immediate vicinity of the bend. The day following, the "heart", or the closed inflorescence appeared in part at the broken place. The appearance was premature since the inflorescence appeared below the usual point of exit and it would have required several days more for the enclosed flower bunch to appear had it done so normally. From that day I began to observe this banana plant closely.

It should be stated that not one of the leaves, which were placed in a hanging position by the bending of the stalk, was cut off. They were found either dried up or in a very advanced stage of drying when the bunch of fruit was cut off, but they struggled to live during the period of the development of the fruit.

When the bracts gradually opened and revealed the young fruits, it was noted that there was absent the normal elongation of the internodes of the fruit stem, or spaces between the "hands". It was also noticed very early that the fruits were undersized although they did not present the lean and rather stunted appearance which characterizes the late appearing fruits at the terminal portion of the bunch. Moreover, no vacant space on the stem appeared between the normal fruits and those which would have been the last and what may be called secondary fruits. Dean Baker and Professor Higgins of this College are of the opinion that the injury might have caused the transformation of the infertile staminate flowers at the end of the bunch into fertile or pistillate ones.

No record was made of the time required to mature the fruit after the appearance of the flowers. However, I have the impression that the time was very much longer than usual. This was due probably to diminished chemical activities in the leaves and the fact that this time included that which would have been spent in the appearance of the inflorescence had it appeared normally.

When the bunch was finally harvested, the stem was loaded thickly with fruit from the first "hand" to the end of the stem. The accompanying illustration does not show the first six hands which contained the larger fruits of the bunch. These were about five centimeters long and one centimeter in diameter. The end portion of the bunch was also cut off and does not appear

[1] Experiment Station contribution, No. 68.

in the plate. When the fruits ripened, it was found that they were normal in taste and color except that they became less sweet and pale yellow toward the end of the bunch. Outside of this and the size, these bananas appeared to be normal, although every one who was shown the fruits thought they belonged to the variety Saguing Maching. On tasting them, however, the characteristic flavor of the Latundal was recognized.

ILLUSTRATION

Plate I

Portion of fruit of Latundal banana which are undersized and thickly set, but otherwise normal, due to the premature appearance of the inflorescence.

PLATE I. PORTION OF FRUIT OF LATUNDAL BANANA WHICH ARE UNDERSIZED AND THICKLY SET, BUT OTHERWISE NORMAL, DUE TO PREMATURE APPEARANCE OF THE INFLORESCENCE.

ABSTRACTS[1]

Cultural study of different varieties of tañgan-tañgan with determination of oil content, Atanacio T. Carandang (*Thesis presented for graduation from the College of Agriculture No. 132; Experiment Station contribution No. 69*).—In his study of tañgan-tañgan (castor oil plant), the author included two distinct lines of investigation: the cultural study of the plant and the determination of oil content.

Cultural studies of Tañgan-tañgan

The experiment included a study of several varieties of the castor oil plant both of foreign and of native origin. Some of the big-seeded varieties were variety numbers, 4442, 7736, 9512, 10135, 10506, and 10508 and some of the small-seeded varieties were variety numbers, 8108, 9007, 9391, 9393, 9394, and 9693.

A kilogram of the big-seeded varieties contained about 1500 seeds and a kilogram of the small-seeded varieties contained about 6000 seeds.

The author found that distancing affected the quantity of bean production. The best distance found was 2.5 meters by 2 meters for the big varieties and 2 meters by 2 meters for the small varieties. The tañgan-tañgan was also tried for its behavior as an intercrop with coffee. The production, however, decreased radically in comparison with the performance in the trial beds. The decrease, which was almost incredible in its proportion, was undoubtedly due to cogon grass in the soil, lack of cultivation, and excess of shade.

It was from four to six months after planting before the first fruiting began. Harvest was made 14 times before the plants were cut down, except with variety numbers 4442, Zanzibariensis, and 7736, Communis, which were harvested only seven times.

From actual observation, the bacterial wilt was the most dreaded enemy; it was caused by *Bacillus solonacearum*. The *Arachea melicerty*, Drury, a moth belonging to the family Noctuideae, attacked the blade of the leaves. Hand-picking was found to be the only practical way of reducing damage.

The result of the experiment showed that the big-seeded varieties had higher yields in every instance than the small-seeded varieties. Variety Zanzibariensis gave the highest yield, 3548.76 kilograms to the hectare; variety Communis ranked second with 3493.20 kilograms to the hectare; and variety Native Red (No. 10135) ranked third with 3445.90 kilograms to the hectare.

Oil determination of the tañgan-tañgan beans

Castor oil has been expressed from cold beans by means of hydraulic press subjected to 350 atmospheres. The oil has also been expressed from cold beans subjected to the same amount of pressure but by repeated heating and by increasing the pressure to 400 atmospheres the amount of expressible oil was in-

[1] Abstracts prepared as part of required theme work in English 4, College of Agriculture.

creased from 2.61 to 5.81 per cent. The cold beans produced an average of 34.84 per cent of oil while the heated beans yielded an average of 36.68 per cent, regardless of variety.

The oil may be extracted by means of ether or chloroform. The titurated seeds were dried and the oil was extracted in Soxhelet apparatus for twenty-four hours. The ether was distilled over to free the oil from ethereal mixture. In extracting oil with chloroform, the samples were placed in a copper extractor for from eight to ten hours. Oil extracted with chloroform was reddish, while that obtained with ether was yellowish. There was not much difference in percentage of oil extracted by the two solvents; the average was 47.5 per cent for each.

According to the results of the comparative determination of expressible oil for the different varieties, it was found out that variety number 7736, Communis, variety number 8107, Los Baños Native, variety number 10506, Spectabilis and variety number 9512, Iloilo, gave the highest percentage.

Abstract by Juan R. Pronto.

Broadcasting and drilling upland rice by native method and by modern machinery, Venerando Marilao (*Thesis presented for graduation from the College of Agriculture No. 133; Experiment Station contribution No. 70*).— The present native method of producing rice in the Philippines gives little or no profit to a farmer. This is due to high cost of production resulting from high cost of labor caused by scarcity of laborers and work animals. To decrease the high cost of production is to decrease the cost of labor. The use of machinery will probably reduce the cost of labor by decreasing the number of men and the amount of time consumed in cultivation.

The author states the object of his work as follows:

> The use of modern machinery on Philippine farms is still in an early stage. The average farmer is still in doubt as to whether or not it would pay to use machinery on rice farms. It was the object of this work to try to find answers to the following questions:
>
> 1. Does it pay to use modern machinery in rice culture in the Philippines?
> 2. What is the advantage of broadcasting and drilling upland rice by modern machinery over the native method of planting upland rice?

The experiment was carried on under the *kasama* system. There were three lots of one-half hectare each. Lot I was prepared and drilled by native method. Lot II and Lot III were prepared by tractor with disc plow and disc harrow. In Lot II the seed was broadcasted by native method and in Lot III it was drilled by machine driller.

The seed used was Inintiw. The rate of seeding was 3.5 gantas to a hectare. All lots were weeded but there was no cultivation with large implements. Weeds grew more thickly in Lot I than in Lots II and III. The stand of the crop in Lot III was better than in the other two lots.

The *yatab* and *lilik*, both native implements, were used in harvesting. The rice was threshed by the harvesters by trampling with the feet. The grain was winnowed with *hunkoy*. Twenty per cent of the clean palay was given to the

harvesters and the remaining 80 per cent was divided equally between the landlord (The College of Agriculture) and the tenant (Venerando Marilao).

The following table shows the expenses involved in the different lot cultures, the yield, and its market valuation and the net profits of the landlord and of the tenant. The data were obtained from the summary of the results of the experiment given in Table VIII of the thesis:

Items	Lot I	Lot II	Lot III
a. Actual yield in cavans	₱ 13.3400	₱ 10.9867	₱ 14.7400
b. Market valuation	90.0450	74.1604	99.4950
c. Landlord and tenants costs	138.4734	139.6395	126.6885
d. Total cost per cavan	10.3803	12.7189	8.5948
e. Landlord:			
1. Gross income	45.0225	37.0802	49.7475
2. Cost	27.1641	42.0446	41.8101
3. Net income	17.8584	—4.9644	7.9374
4. Investment	153.5836	170.3320	170.9160
5. Rate of interest on investment	.1162	—.0027	.0464
f. Tenant:			
1. Gross income	45.0225	37.0802	49.7475
2. Cost	111.3093	97.5949	84.8784
3. Net income	66.2868	—60.5147	—35.1309
4. Hours of labor	156.3333	148.2500	106.5000
5. Income per hour	—.4240	—.4084	—.3299

From the data given, it was shown that Lot III gave the highest yield and Lot II, the lowest. The yields showed that drilling gave a better crop than broadcasting, and that drilling by machinery gave a better crop than drilling by the native method. The author found that the cost of a cavan in Lot I was ₱10.3803, in Lot II, ₱12.7189 and in Lot III, ₱8.5948. This shows that it is cheaper in rice culture to use machinery throughout than to use it only for preparing the land or not to use it at all. In these three methods of rice culture the landlord made a little profit in Lot I and Lot III and sustained a loss in Lot II. His loss, however, was no greater than the tenant's in any of the three cultures. The tenant incurred a minimum loss in Lot III.

Under Los Baños conditions tractor and disc plow may be used in lowland rice culture successfully. It can be managed by two persons and the work obtained is satisfactory. Also it takes a shorter time to put a certain area of land under cultivation than with animal power. The cost of labor is somewhat lower by the use of machinery than by the use of hand labor. The broadcasting method is less profitable than the use of drilling machine or drilling by native method. The drilling by machine driller gave higher production than by the native method.

Machinery puts the land in a condition that is suitable to rice growth but not to weeds, consequently the production will be higher. From the experiment recorded and discussed in the thesis, the use of machinery in the Philippines may be advocated in lowland rice cultures under special conditions similar to those of Los Baños.

Abstract by Alberto A. Estrada.

WEATHER OBSERVATIONS, JANUARY, 1921.

Observer—R. P. Estioko

At College.

Date.	Rainfall.		Temperature.				Wind.		Cloudiness.
	Daily.	Weekly.	Maximum.	Minimum.	Daily.	Weekly.	Daily.	Weekly.	
Jan.	*mm.*	*mm.*	*°C.*	*°C.*	*°C.*	*°C.*	*miles*	*miles*	
1	4.0	11.1	26.3	21.8	24.0	24.0	21.7	593.5	¾ cloudy
2	T		26.4	22.1	24.3		91.3		cloudy
3	T		26.4	22.6	24.3		83.3		¾ cloudy
4	4.1		26.5	22.1	24.3		117.3		cloudy
5	0.8		26.5	22.6	24.5		93.4		cloudy
6	O		26.5	21.9	24.2		108.6		½ cloudy
7	3.1		25.9	20.8	23.4		68.4		cloudy
8	6.3	8.3	24.5	21.6	23.0	24.0	81.3	647.6	¾ cloudy
9	1.0		27.0	21.6	24.3		133.8		cloudy
10	3.2		25.0	22.1	23.6		102.7		cloudy
11	O		26.9	22.0	24.4		120.9		¾ cloudy
12	O		26.0	20.9	23.5		103.3		¾ cloudy
13	0.3		26.3	20.8	23.5		68.9		¾ cloudy
14	O		27.0	21.0	24.0		75.4		cloudy
15	2.1	6.6	25.5	22.6	24.1	23.9	129.2	734.2	¾ cloudy
16	1.0		24.8	22.6	23.7		106.3		cloudy
17	1.1		27.5	22.6	25.0		84.3		¾ cloudy
18	0.7		27.2	21.6	24.4		85.4		½ cloudy
19	1.0		27.0	21.4	24.2		69.4		cloudy
20	O		27.0	21.6	24.3		76.6		½ cloudy
21	O		27.2	20.6	23.9		80.8		½ cloudy
22	O	3.8	27.6	20.1	23.8	24.0	65.0	567.8	¾ cloudy
23	O		27.5	22.6	25.1		98.7		¾ cloudy
24	O		28.0	22.6	25.5		114.1		cloudy
25	O		26.2	21.6	23.9		110.7		¾ cloudy
26	O		26.2	21.1	23.6		103.2		cloudy
27	1.5		27.0	21.2	24.1		140.7		¾ cloudy
28	O		26.8	22.4	24.6		91.0		½ cloudy
29	O	1.5	26.1	22.4	24.3	24.4	70.8	729.2	cloudy
30	O		24.3	22.4	23.3		43.4		cloudy
31	T		25.1	22.4	23.8		80.3		cloudy
Monthly		21.2	26.3	21.8	24.1		91.5	2829.2	

On Mount Makiling

Station on Mount Makiling.	Dates.	Rainfall.	Temperature.		
			Maximum.	Minimum.	Mean.
College Coffee Plantation.....	Jan. 3 to Jan. 9	20.6	28.2	18.0	23.1
	Jan. 10 to Jan. 16	15.7	29.0	18.0	23.5
	Jan. 17 to Jan. 23	5.0	30.0	18 0	24.0
	Jan. 24 to Feb. 3	11.4	30.5	18.6	24.5
450 Meters Elevation.....	Jan. 3 to Jan. 9	15.1			
	Jan. 10 to Jan. 16	17.2			
	Jan. 17 to Jan. 23	5.5			
	Jan. 24 to Feb. 3	12.5			
Summit.....	Jan. 3 to Jan. 9	23.4	17.4	16.7	17.1
	Jan. 10 to Jan. 16	20.2	17.3	16.5	16.9
	Jan. 17 to Jan. 23	7.5	18.7	16.9	17.8
	Jan. 24 to Feb. 3	15.6	17.3	16.4	17.0

WEATHER OBSERVATIONS, FEBRUARY, 1921.

Observer—R. P. Estioko

At College

Date	Rainfall		Temperature				Wind.		Cloudiness.
	Daily.	Weekly.	Maximum.	Minimum.	Daily.	Weekly.	Daily.	Weekly.	
Feb.	*mm.*	*mm.*	*°C*	*°C*	*°C*	*°C*	*miles*	*miles*	
1	3.3		26.2	22.1	24.1		138.6		cloudy
2	O		29.7	21.6	25.7		57.8		½ cloudy
3	O		29.0	22.0	25.5		57.7		¾ cloudy
4	4.9		26.2	22.3	24.2		116.7		cloudy
5	O	8.2	27.0	22.6	24.8	24.8	35.2	534.7	½ cloudy
6	2.5		27.8	22.6	25.2		67.1		½ cloudy
7	O		27.0	22.6	24.8		98.9		¾ cloudy
8	O		28.4	22.6	25.5		48.6		¾ cloudy
9	O		30.2	21.6	25.9		52.6		½ cloudy
10	O		30.0	21.6	25.8		64.2		½ cloudy
11	O		29.5	21.6	25.6		60.0		½ cloudy
12	2.3	4.8	24.0	24.5	24.2	25.2	79.9	471.3	cloudy
13	.4		27.1	22.6	24.9		135.1		cloudy
14	O		27.3	23.6	25.4		107.7		½ cloudy
15	O		29.5	23.0	26.3		114.6		cloudy
16	O		29.0	21.6	25.3		87.0		½ cloudy
17	O		27.2	20.7	23.9		84.1		¾ cloudy
18	1.6		24.0	22.5	23.3		84.6		cloudy
19	1.4	3.4	26.0	22.2	24.1	24.7	83.3	696.4	cloudy
20	.3		25.0	22.4	23.7		74.0		cloudy
21	O		26.8	22.5	24.6		91.4		cloudy
22	.6		24.5	22.4	23.3		169.8		¾ cloudy
23	O		25.0	21.6	23.3		139.7		cloudy
24	.5		25.3	22.4	23.8		100.5		cloudy
25	1.2		25.4	21.6	23.5		121.8		cloudy
26	O	2.6	27.3	22.6	25.0	23.8	83.4	780.6	½ cloudy
27	O		28.8	22.6	25.7		83.1		½ cloudy
28	O	O	32.0	23.6	27.8		83.9		½ cloudy
Monthly		19.0	26.3	22.3	24.5	24.8	90.0	2521.3	

On Mount Makiling

Station on Mount Makiling.	Dates.	Rainfall.	Temperature.		
			Maximum.	Minimum.	Mean.
College Coffee Plantation	Jan. 24 to Feb. 3	11.4	30.5	18.6	24.5
	Feb. 4 to Feb. 6	8.4	31.0	18.0	24.5
	Feb. 7 to Feb. 13	4.0	30.9	19.4	24.7
	Feb. 14 to Feb. 20	5.7	31.7	18.6	25.1
	Feb. 21 to Feb. 27	12.6	29.4	18.5	23.9
450 Meters Elevation	Jan. 24 to Feb. 3	12.5			
	Feb. 4 to Feb. 6	9.6			
	Feb. 7 to Feb. 13	4.4			
	Feb. 14 to Feb. 20	5.9			
	Feb. 21 to Feb. 27	13.7			
Summit	Jan. 24 to Feb. 3	15.6	17.4	16.7	17.1
	Feb. 4 to Feb. 6	10.2	19.4	17.0	18.2
	Feb. 7 to Feb. 13	5.6	19.1	16.8	17.9
	Feb. 14 to Feb. 20	6.2	18.3	16.9	17.6
	Feb. 21 to Feb. 27	15.6	16.4	15.6	16.0

WEATHER OBSERVATIONS, MARCH, 1921.

Observer—R. P. Estioko

At College

Date.	Rainfall.		Temperature.				Wind.		Cloudiness.
	Daily.	Weekly.	Maximum.	Minimum.	Daily.	Weekly.	Daily.	Weekly.	
March	*mm.*	*mm.*	*°C.*	*°C.*	*°C.*	*°C.*	*miles*	*miles*	
1	0		32.0	22.9	27.4		77.4		½ cloudy
2	0		33.2	22.4	27.8		87.6		½ cloudy
3	0		32.0	23.4	27.7		73.4		¼ cloudy
4	0		31.5	23.3	27.4		45.9		½ cloudy
5	T	T	29.2	23.6	26.4	27.2	115.3	399.6	¾ cloudy
6	8.0		26.0	23.4	24.7		96.3		cloudy
7	24.3		26.2	22.6	24.4		80.1		cloudy
8	T		28.0	22.1	25.1		113.0		cloudy
9	1.4		29.0	22.7	25.8		124.1		½ cloudy
10	3.9		28.6	22.6	25.6		129.1		cloudy
11	1.4		29.2	22.2	25.7		119.6		½ cloudy
12	0	39.0	30.8	21.6	26.2	25.4	65.5	727.7	¼ cloudy
13	0		28.5	22.6	25.6		79.2		¾ cloudy
14	9.6		24.6	23.6	24.1		64.5		cloudy
15	2.3		26.8	23.0	24.9		124.2		cloudy
16	0		27.5	22.5	25.0		105.8		cloudy
17	0		31.0	22.6	26.8		115.2		cloudy
18	0		27.6	22.2	24.9		103.5		cloudy
19	0	11.9	28.0	23.5	25.7	25.3	64.0	656.4	cloudy
20	2.0		30.5	23.1	26.8		87.3		cloudy
21	0		31.8	23.6	27.7		56.9		½ cloudy
22	0		31.3	23.3	27.4		79.0		¼ cloudy
23	1.2		32.0	23.2	27.6		55.7		¼ cloudy
24	0		30.2	22.9	26.6		81.7		½ cloudy
25	0		31.0	22.9	26.9		84.4		¼ cloudy
26	0	3.2	31.0	22.8	26.9	27.1	110.2	555.2	¼ cloudy
27	0		30.8	23.2	27.0		74.1		¾ cloudy
28	0		29.3	23.4	26.4		92.3		½ cloudy
29	0		31.0	23.2	27.1		136.0		½ cloudy
30	0		31.0	22.6	26.9		102.7		½ cloudy
31	0		31.2	23.1	27.1		68.1		¼ cloudy
Monthly		54.1	29.7	22.9	26.3		90.7	2812.1	

On Mount Makiling

Station on Mount Makiling.	Dates.	Rainfall.	Temperature.		
			Maximum.	Minimum.	Mean.
College Coffee Plantation	Feb. 28 to Mar. 6	6.2	29.8	18.0	23.9
	Mar. 7 to Mar. 13	41.7	33.0	19.5	26.2
	Mar. 14 to Mar. 20	20.4	33.8	19.2	26.5
	Mar. 21 to Mar. 27	2.9	33.9	19.5	26.7
	Mar. 28 to April 3	1.4	33.9	20.0	27.0
450 Meters Elevation	Feb. 28 to Mar. 6	6.7			
	Mar. 7 to Mar. 13	43.5			
	Mar. 14 to Mar. 20	22.5			
	Mar. 21 to Mar. 27	3.1			
	Mar. 28 to April 3	1.8			
Summit	Feb. 28 to Mar. 6	8.0	21.0	18.6	20.2
	Mar. 7 to Mar. 13	45.2	19.0	17.3	18.2
	Mar. 14 to Mar. 20	31.7	18.5	17.1	17.8
	Mar. 21 to Mar. 27	5.5	21.6	18.3	19.9
	Mar. 28 to April 3	2.5	20.2	17.9	19.0

WEATHER OBSERVATIONS, APRIL, 1921.

Observer—R. P. Estioko

At College

Date.	Rainfall.		Temperature.				Wind.		Cloudiness.
	Daily.	Weekly.	Maximum.	Minimum.	Daily.	Weekly.	Daily.	Weekly.	
April	*mm.*	*mm.*	*°C.*	*°C.*	*°C.*	*°C.*	*miles*	*miles*	
1	0		31.7	22.3	27.0		79.0		¼ cloudy
2	0	0	30.8	22.0	26.4	26.8	89.0	641.2	½ cloudy
3	0		34.2	21.6	27.9		44.7		¼ cloudy
4	0		31.1	22.9	27.0		67.5		½ cloudy
5	1.9		30.5	22.2	26.3		92.2		¾ cloudy
6	2.5		30.2	22.6	26.4		92.5		½ cloudy
7	0		30.9	23.0	27.0		77.1		½ cloudy
8	0		32.5	22.1	27.3		74.3		¼ cloudy
9	0	4.4	30.0	21.8	25.9	26.8	72.2	520.5	½ cloudy
10	0		30.5	21.8	26.1		103.5		¼ cloudy
11	3.3		30.6	21.6	26.1		52.5		¼ cloudy
12	0		33.8	22.6	28.2		49.5		½ cloudy
13	0		32.4	22.8	27.6		49.4		¼ cloudy
14	0		32.4	22.9	27.7		56.3		cloudy
15	0		32.5	24.8	28.6		64.8		cloudy
16	0	3.3	33.2	24.4	28.8	27.6	53.5	429.5	cloudy
17	0		33.8	23.5	28.6		40.2		½ cloudy
18	0		32.2	24.4	28.3		102.2		½ cloudy
19	0		31.4	23.2	27.3		80.6		½ cloudy
20	0		31.0	23.6	27.3		87.5		¾ cloudy
21	0		31.5	23.4	27.5		89.4		½ cloudy
22	0		32.0	24.1	28.0		91.2		¼ cloudy
23	.9	.9	30.2	24.2	27.2	27.7	102.3	593.4	¾ cloudy
24	0		31.0	23.2	27.1		107.7		clear
25	4.2		31.4	24.5	28.0		57.8		¼ cloudy
26	0		33.0	24.1	28.5		73.3		½ cloudy
27	0		32.2	24.1	28.2		102.1		¼ cloudy
28	0		31.0	22.5	26.7		92.8		¼ cloudy
29	0		32.0	22.9	27.5		109.2		clear
30	0	4.2	31.0	22.6	26.8	27.5	96.4	639.3	¼ cloudy
Monthly		12.8	31.7	23.1	27.4		78.4	2350.7	

On Mount Makiling

Station on Mount Makiling.	Dates.	Rainfall.	Temperature.		
			Maximum.	Minimum.	Mean.
College Coffee Plantation	April 4 to April 10	4.7	34.1	20.2	27.1
	April 11 to April 17	2.1	35.0	18.8	26.9
	April 18 to April 24	2.4	34.8	19.1	27.0
	April 25 to May 1	11.1	34.0	20.0	27.0
450 Meters Elevation	April 4 to April 10	4.1			
	April 11 to April 17	2.0			
	April 18 to April 24	2.2			
	April 25 to May 1	12.6			
Summit	April 4 to April 10	5.5	20.4	17.3	18.8
	April 11 to April 17	4.6	21.7	18.3	20.0
	April 18 to April 24	1.5	21.1	18.8	20.0
	April 25 to May 1	10.8	20.6	18.2	19.4

WEATHER OBSERVATIONS, MAY, 1921

Observer—R. P. Estioko

At College

Date.	Rainfall.		Temperature.				Wind.		Cloudiness.
	Daily.	Weekly.	Maximum.	Minimum.	Daily.	Weekly.	Daily.	Weekly.	
May	*mm.*	*mm.*	*°C.*	*°C.*	*°C.*	*°C.*	*miles*	*miles*	
1	0		32.2	21.8	27.0		74.4		clear
2	0		33.6	23.0	28.3		81.0		¼ cloudy
3	0		34.0	23.1	28.5		61.3		¾ cloudy
4	0		32.2	23.4	27.8		65.5		¾ cloudy
5	0		33.5	23.1	28.3		52.6		½ cloudy
6	0		32.5	23.0	27.7		44.5		¾ cloudy
7	0	0	33.8	23.6	28.7	28.0	49.1	428.4	¾ cloudy
8	0		33.0	22.6	27.8		67.2		¾ cloudy
9	0		34.0	24.1	29.0		70.4		cloudy
10	0		32.5	24.0	28.2		69.3		½ cloudy
11	0		32.6	23.2	27.9		84.7		¼ cloudy
12	0		33.2	24.1	28.7		80.2		½ cloudy
13	0		33.8	24.6	29.2		111.3		½ cloudy
14	0	0	34.0	25.1	29.5	28.6	74.2	556.9	¾ cloudy
15	0		34.5	24.1	29.3		73.1		clear
16	0		33.4	24.1	28.7		58.0		cloudy
17	0		32.4	23.6	28.0		100.9		¾ cloudy
18	34.5		30.8	25.1	27.9		89.2		cloudy
19	17.8		28.0	23.9	25.9		88.5		cloudy
20	18.0		31.0	23.1	27.0		51.6		cloudy
21	3.0	75.3	31.6	22.9	27.2	27.7	75.0	536.3	cloudy
22	2.7		30.2	23.0	26.6		45.1		cloudy
23	0		33.0	23.2	28.1		66.4		¾ cloudy
24	T		33.0	23.1	28.0		55.0		cloudy
25	1.1		32.9	24.1	28.5		54.3		½ cloudy
26	0		33.3	24.1	28.7		62.6		¾ cloudy
27	0		34.0	23.6	28.8		63.5		½ cloudy
28	0	3.8	32.4	23.6	28.0	28.1	45.0	391.9	¾ cloudy
29	0		32.0	23.6	27.8		52.9		½ cloudy
30	45.2		32.5	23.4	27.9		57.2		½ cloudy
31	10.0		31.2	22.6	26.9		59.5		¼ cloudy
Monthly		134.3	32.6	23.5	28.0		67.2	2083.1	

On Mount Makiling

Station on Mount Makiling.	Dates.	Rainfall.	Temperature.		
			Maximum.	Minimum.	Mean.
College Coffee Plantation	May 2 to May 8	4.8	34.3	20.0	27.1
	May 9 to May 15	0	34.8	20.2	27.5
	May 16 to May 22	127.6	34.0	20.5	27.3
	May 23 to May 29	4.7	34.6	20.5	27.5
450 Meters Elevation	May 2 to May 8	5.4			
	May 9 to May 15	0			
	May 16 to May 22	117.6			
	May 23 to May 29	5.2			
Summit	May 2 to May 8	13.7	21.9	17.6	19.7
	May 9 to May 15	T	22.4	18.7	20.6
	May 16 to May 22	52.7	22.4	19.2	20.8
	May 23 to May 29	1.5	23.5	17.8	20.7